Now, in the form in which the theory has been developed by Pearson and Yule, the "total correlation coefficient," showing the combined effect of all the factors upon X_1, is

$$R_{1.234\cdots n}=\sqrt{[1-(1-r^2_{12})(1-r^2_{13.2})(1-r^2_{14.23})\cdots(1-r^2_{1n.234\cdots(n-1)})]} \quad (6)$$

in which

$$r_{12.34\cdots i}=\frac{r_{12.34\cdots(i-1)}-(r_{1i.34\cdots(i-1)})(r_{2i.34\cdots(i-1)})}{\sqrt{1-(r^2_{1i.34\cdots(i-1)})(1-r^2_{2i.34\cdots(i-1)})}} \quad (7)$$

is the net coefficient of correlation between X_1 and X_2 after the effects of X_3, ... X_i have been eliminated. The regression equation (3) becomes

$$x_1=b_{12.34\cdots n}x_2+b_{13.24\cdots n}x_3+\cdots+b_{1n.23\cdots(n-1)}x_n, \quad (8)$$

where

$$b_{12.34\cdots n}=r_{12.34\cdots n}\frac{\sigma_{1.34\cdots n}}{\sigma_{2.34\cdots n}}, \text{ etc.,} \quad (9)$$

$$\sigma_{1.34\cdots n}=\sigma_1\sqrt{(1-r^2_{13})(1-r^2_{14.3})\cdots(1-r^2_{1n.34\cdots(n-1)})}. \quad (10)$$

Walker has shown the identity of his m and Yule's $R_{1.234\cdots n}$; and it is not difficult to show that the numerical values of the coefficients given by (4) and (9) are identical, but are much more easily obtained by the following device due to Walker:

Write (3) in the form

$$\frac{x_1}{\sigma_1}=c_2\frac{x_2}{\sigma_2}+c_3\frac{x_3}{\sigma_3}+\cdots+c_n\frac{x_n}{\sigma} \quad (11)$$

by replacing a_{1i} with $c_i\frac{\sigma_1}{\sigma_i}$; the ratios of the actual departures from the averages to the standard deviations, x_i/σ_i, Walker calls the "proportional departures." Then it may be shown that

$$m^2=c_2^2+c_3^2+c_4^2+\cdots+c_n^2+2c_2c_3r_{23}+2c_2c_4r_{24}+\cdots+2c_3c_4r_{34}+\cdots. \quad (12)$$

Furthermore, since

$$x_i=r_{ij}\frac{\sigma_i}{\sigma_j}x_j, \quad (13)$$

we have

$$\begin{aligned} r_{12}&=c_2r_{22}+c_3r_{23}+c_4r_{24}+\cdots+c_nr_{2n},\\ r_{13}&=c_2r_{23}+c_3r_{33}+c_4r_{34}+\cdots c_nr_{3n},\\ &\cdots\cdots\cdots\cdots\\ r_{1n}&=c_2r_{2n}+c_3r_{3n}+c_4r_{4n}+\cdots+c_nr_{nn}, \end{aligned} \quad (14)$$

$(n-1)$ simultaneous linear equations from which the c's may be found, by employing any of the well known shortened methods of solving such a set of equations.[4]

Thus the total correlation coefficient and the regression equation may be found without computing any of the great number of net correlations required by the usual methods.

[4] See E. T. Whittaker and G. Robinson. *The Calculus of Observations*, London, 1924. Chap. V, and *Arts*, 121, 117.

NOTES, ABSTRACTS, AND REVIEWS

FOUR WIRELESS STATIONS TO BE ERECTED IN GREENLAND

(Excerpts from report by J. D. Price, United States minister, Copenhagen, Denmark, March 10, 1924)

The parliamentary committee on finance has now granted an appropriation of about 700,000 crowns [$170,327.00] for the erection of four wireless stations (of the Danish Poulsen system) on Greenland, which Continent will thus be enabled to share directly in world intercourse. The stations are also expected to prove of both direct and indirect value to commerce and science, especially to the international weather service.

The stations, which are to be constructed by the Danish Radio Co. of Danish material supplied by Skoumann & Petersen and other Danish firms, are to be located at Angmagsalik (on the eastern coast), Julianehaab (southern point of Cape Farewell), Godhavn and Godthaab (both on the western coast). The main station is to be at Julianehaab and is to be of sufficient capacity under normal conditions to correspond with the present stations at Reykjavik (Iceland) and Thorshavn (Faeroes), and under especially favorable conditions, to reach the main Danish station at Lyngby (near Copenhagen) and the European Continent.

Three of the stations are to be adapted for telegraphic communication with continuous waves, and to be fitted with spark transmitters for local correspondence.

FRANK HAGAR BIGELOW, 1851-1924

Professor Bigelow was born at Concord, Mass., of sturdy New England antislavery stock. He was graduated from Harvard in the class of 1873, and soon thereafter entered the Episcopal ministry. The development of an affection of the lungs cut short his ministerial career, although he was in close affiliation with the church throughout his whole life. In seeking a dry climate his attention was directed to Argentina where a former Harvard graduate, the late Dr. B. A. Gould, was engaged in astronomical work. Bigelow served as assistant to Doctor Gould, 1873–1876 and again 1881–1883. Returning from South America he was successively professor of mathematics, Racine College, 1884–1889 and assistant in the Nautical Almanac Office, 1889–1891, member of United States Eclipse expeditions, to West Africa, 1889; Newberry, S. C., 1900; Spain, 1905. He was appointed professor of meteorology in the United States Weather Bureau in October, 1891, and resigned in 1910. He spent the next 11 years with the meteorological service of Argentina, being stationed for the most part at Cordoba and Pilar. On his retirement from that service in 1921 he went first to Marseilles, France, and later to London. Finally, he went to Vienna where he died of pneumonia on March 2, 1924. His wife survived him but a few days and succumbed to the same disease

Professor Bigelow was by nature a student-investigator and was possessed of a seemingly inexhaustible supply of energy backed by the will to pursue any subject that he might take up until the end.

Perhaps his outstanding piece of work while with the Weather Bureau was his contribution to the subject of the general circulation of the atmosphere in a series of related papers that were published in the MONTHLY WEATHER REVIEW, 1902–1906. Previous to the writing of these papers he had finished two ponderous volumes, the first on the international cloud observations, and the second on the barometry of the United States. Both

publications appeared as the second volume of the Report of the Chief of Weather Bureau, for the years, 1899–1900 and 1900–1901, respectively. His last important piece of work while with the Weather Bureau was an investigation of the evaporation of Salton Sea, a body of water that filled a depression in southeastern California by overflow from the Colorado River.

In 1904 Professor Bigelow advocated a very elaborate project for a scientific organization in the Weather Bureau for research and investigation into atmospheric, electrical, and magnetic phenomena and their correlation with solar characteristics. This was partly carried into effect in the institution known as Mount Weather, but his connection with the bureau was severed without his ambitions in this connection being attained. The present writer was closely associated with Professor Bigelow during the latter's service in the bureau.

Personally, he was reserved and was not what is commonly called a "good mixer."

Owing to the highly mathematical and often obscure character of his papers the leading officials of the Weather Bureau found it difficult to follow the force of his arguments or concur in the integrity of his conclusions. This led to a sort of isolation of the author, which fact Bigelow no doubt felt rather keenly at times. Indeed, discouragement at the outlook probably was an important factor in the termination of his connection with the bureau.

As his investigations into the general circulation of the atmosphere progressed he found himself departing more and more widely from the views held by Ferrel and other early writers. Before he left the Weather Bureau in 1910, the idea of entirely revamping meteorology had taken possession of him, at first as a mild sort of obsession, which later became the impelling object of his existence. With the infirmities of age bearing upon him and not meeting with the responses that he thought were due his labors, it is not strange that his occasional letters to his old associates were tinged with more or less bitterness against those who withheld their approval of his radical views and system.

He published in New York in 1915 a treatise on Circulation and Radiation in the atmospheres of the earth and of the air. While this publication apparently presented his final views he followed it by supplements, of which 5 were issued, the final supplement, No. 5 of the series, bears the following suggestive title: "The New Must Replace the Old, Delenda est Carthago, Atmospheric Physics as Applied to a Reformed Meteorology."

One can not but admire the indomitable spirit of the man, doubtless inherited from his militant New England ancestors. Like the martyrs of old he went down with his colors flying. Broken by the infirmities of age, and in a foreign land his last communication to the Weather Bureau, couched in the same spirit as the earlier ones, was dated Vienna, February 21. Ten days later he passed away. His remains, together with those of his wife, were brought to this country and interred at Concord, Mass., his birthplace, on April 12, 1924.—*A. J. Henry.*

BORIS WEINBERG APPOINTED DIRECTOR

Announcement has recently been received of the appointment on January 30, 1924, of Prof. Boris Weinberg as the new director of the Central Physical Observatory at Leningrad (formerly Petrograd).

WEATHER BUREAU STAFF MEETINGS[1]

Following is a continuation of the program of the Weather Bureau staff meetings:

MARCH 5, 1924

C. F. Marvin: The Sun Spot period in terrestrial temperatures.

MARCH 19, 1924

C. P. Olivier: Professor of astronomy in the Leander McCormick Observatory, University of Virginia (by invitation): Meteors.

APRIL 2, 1924

E. H. Bowie: Diagnosing synoptic weather charts.

APRIL 16, 1924

A. J. Henry: Seasonal forecasting in India (based on the work of Dr. Gilbert T. Walker).

MAY 7, 1924

S. P. Fergusson: An improved anemometer for general use.
P. C. Day: Difficulties in reducing wind velocities to a uniform standard.

MAY 22, 1924

E. H. Bowie: The problem of the daily weather map. A suggested solution.

With this meeting the series closes until autumn of 1924.—A. J. H.

[1] Cf. this REVIEW, 52: 35-36.

BIBLIOGRAPHY

C. FITZHUGH TALMAN, Meteorologist in Charge of Library

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies.

Anglada, Josep.

Sondatges de l'atmòsfera lliure a Barcelona, amb globus pilots, des del 1. er de Juliol al 31 de Desembre de 1923. Barcelona. 1924. 32 p. 21½ cm. (Servei met. de Catalunya. Notes d'estudi. N.° 28.)

Braak, C.

Het klimaat van Nederlandsch-Indie. v. 1. pt. 4. Batavia. 1923. v. p. plates (part fold.) 27½ cm. [K. Mag. en met. obs. Batavia. Verh. 8.] [With English summaries.]

Burns, George P.

Studies in tolerance of New England forest trees. no. 4. Minimum light requirement referred to a definite standard. Burlington. 1923. 32 p. figs. plates. 23 cm. (Vt. agric. exp. sta., July, 1923. Bulletin 235.)

Chu, Co-Ching.

Climate of Nanking. [18 p.] 25½ cm. [Title and text in Chinese.]

Eredia, Filippo.

Contributo della Sicilia agli studi geofisici. Castello. 1923. 20 p. 26½ cm. (Estr.: Atti Soc. ital. per il prog. sci. 12 riunione. Catania, Apr., 1923.)

Le divisioni dell' anno a seconda dei fenomeni meteorologici. 6 p. 27½ cm. [Estr.: Boll. bimen. Soc. met. ital., N. 1–3, Gen.–Marzo 1924.]